SCIENCE:

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EVIDENCE OF TWO PRE-MORAINIC GLACIAL MOVEMENTS.[1]

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THE valley of Rock River, running southward through southern Wisconsin and northern Illinois, is a very deep pre glacial erosion gorge, cut through Lower Silurian rocks and filled with assorted, incoherent glacial sands and gravels. Artesian wells go down several hundred feet through these gravels before striking rock. The region lies to the south of the great terminal moraine.

Along the bluffs of this valley, at various points, there is exposed a conglomerate, composed also of glacial gravels; it is a pudding stone, thoroughly indurated, so as to make an excellent rock for cellar-walls and the like; in some cases it is cemented together by a calcareous matrix, in other cases there is a large percentage of iron hydroxide in the cementing material.

I have long known some of these outcrops, and have been puzzled by them; but have supposed that they were due to local causes affecting the gravels which everywhere fill the broad valley; but some more careful observations this summer reveal these facts:—

1. They rise, in every case that I have observed, ten to twenty feet above the river bottoms.

2. They are overlaid in some cases by the boulder-clay, containing unassorted, striated pebbles.

3. They occur, so far as I can discover, and I am pretty familiar with the region, which was my native county, only on the extreme edge of the bluffs overlooking the broad river bottoms, or on the bluffs of valleys of some width which were tributaries to the main valley when its latest bottoms were formed. They appear, in other words, to be remnants of older gravels which once filled the valley, but were mostly cut away by the floods which deposited the later, unconsolidated gravels now filling the valley and constituting its flood-plain at a level of ten to twenty feet below the top of the conglomerate. In one place the extreme face of the bluff, immediately below an outcrop of the conglomerate, was made up of layers of the light-colored, incoherent gravels, alternating with dark, iron-stained material, evidently derived from the older conglomerate, which then formed the bluffs against which the stream washed.

This distinction of age is confirmed by the occurrence of the ground moraine of the latest glacial movement in this region, overlying the consolidated gravels.

There is no decisive evidence that the interval between these movements was one of great duration, but the striking contrast in appearance between the loose gravels and the conglomerate tends to impress one with the idea that the latter is relatively very old. So striking is this appearance, that at one exposure which I visited I found the owner of the field laboriously digging up an outcropping mass of this conglomerate, somewhat harder and redder than usual, under the supposition that it was a meteorite, which he purposes to take in to Chicago next year for an exhibit.

[1] Paper read before the Nebraska Academy of Sciences, Dec. 27, 1892.

A further consideration, which would seem to imply a considerable interval between the two movements, is that the following succession of events would seem called for to explain the facts: —

1. A glacial movement bringing the material of which the conglomerate is composed, and which includes about the usual proportion of local and remote ingredients.

2. A melting of the ice and floods, surpassing in extent those of the later epoch, for the conglomerate, as before stated, lies regularly at a higher level than the later gravels.

3. Another forward movement of the ice to account for the ground moraine overlying the conglomerate; and

4. Another melting of the ice to deposit the later gravels.

SOME NOTES ON LIGHTHOUSE APPARATUS.

BY J. KENWARD, C.E., F.S.A., BIRMINGHAM, ENGLAND.

IN 1851, the United States possessed four sea-lights on the dioptric system. In 1891 the number was of sea-lights 138, of harbor lights 526, in addition to about 100 of the small apparatus called range-lenses and lens-lanterns.

This magnificent progress in forty years reflects the highest credit on the Government and on its nautical and engineering officers. Under official auspices in 1851, a most exhaustive enquiry was promoted into the merits of the dioptric or refracting system of lights of Augustin Fresnel in comparison with the catoptric or reflecting system which it had begun to supersede. The result having been ascertained to prove a sevenfold superiority for the dioptric system, the government authorized the lighting of the United States coast-line on an imposing scale, and it has ever since taken a watchful and intelligent interest in the advancement of lighthouse science, and in the gradual provision of the best forms of optical and mechanical apparatus.

The steps of progress, indeed, in lighthouse design and construction have been many and important. The first home of this industry was in France, where the illustrious mathematician and physicist to whose practical genius the lenticular system is due, lived his short life, dying in 1827. The celebrated Tour de Cordouan, at the mouth of the Garonne, was the first lighthouse to receive the new installation of his lenses. The names of Leonar Fresnel, brother of Augustin, of Soleil, Letourneau, Lepaute, Sautter, Barbier, Degrand, Allard, Reynaud, Bourdelles, Bernard, and others follow in brilliant succession in France, as engineers, constructors, or contributors to the literature of the subject; while in the United Kingdom the great family of the Stevensons, Mr. James Chance, Dr. John Hopkinson, Sir James Douglass and Mr. Wigham of Dublin, may be cited as equally distinguished.

Nor have the authorities of the United States, while availing themselves fully of the labors and researches of all these experts, been backward in adding American names to the list of honor. To mention only three, General Alexander, Major George Elliot, and Major D. P. Heap are worthy, in their special work, of the country of such men of science as Professor Henry and Professor Newcomb.

It is particularly to Major Heap of New York that credit is due not only in selecting the most novel and striking forms of apparatus produced in Europe, but also in promoting the design and construction in the States, of the lanterns, lamps, clockwork, pedestals, etc., which are indispensable to it. Major Heap is the author, too, of an excellent compilation on lighthouses.

Let me glance at some of the past achievements and present resources of lighthouse science.

During the past ten or fifteen years the great extension of commerce, the opening of new ports, the multiplication of steam vessels of all classes, and the striking acceleration of their speed, have affected lighthouses and lightships in the three essential points of number, power, and distinctiveness. The chief maratime countries of the world — the United States, Great Britain and her colonies and dependencies, France, Holland, Italy, and Denmark, have endowed their coasts with an imposing array of

lights, and their needs are not nearly satisfied. It was eloquently said by the Secretary of State at the International Marine Conference at Washington in 1889: "The spoken languages of the world will continue to be many, but necessity commands that the unspoken language of the sea shall be one." Thus the signal-lighting of the sea-coasts and of the ships traversing the sea is a work truly and emphatically international — a work which neither in its magnitude nor its variety suggests any notion of finality. For instance, the English Admiralty published in 1862 forty notices to mariners in relation to lights, buoys, dangers, etc., in all the work. In 1892 its similar notices amounted to over 600.

The considerations of power or intensity and of distinctiveness were naturally on the numerical increase of lighthouses. The early illuminating apparatus of Fresnel and his successors were mainly confined to two forms, fixed and revolving, the latter being approximately from six to eight times as powerful as the former, the four-wick vegetable oil flame being the brightest illuminant in both. Subsequently composite lights of both fixed and revolving sections were adopted, as well as more effective flames. Next followed the important enhancement of revolving apparatus by the holophotal system of Thomas Stevenson, who also introduced the use of condensing prisms and of mirrors for fixed lights, and who lastly, after many minor improvements, suggested the maximum size of lens yet attained, called the hyper-radial — a light particularly suited to great headlands and other stations where ranges of visibility of thirty or forty miles are necessary. The increase *pari passu* of the potency of lamps — thanks chiefly to the unwearied and intelligent labors of Sir James Douglass with petroleum, and of Mr. Wigham of Dublin with gas — has given due effect to these great developments of dimension. The first-order revolving light shortly to be established on Heceta Head, Oregon, the work of Messrs. Chance of England, is an example of the holophotal system with twenty six prisms of a radius of 920 millimetres. Mosquito Inlet, Florida, erected in 1887, is an example of a hyper-radial fixed light of 1330 millimetres radius, with prisms, on the holophotal system. This was constructed by Messrs. Barbier & Co. of Paris. Dondra Head and Barberyn, Ceylon, are examples of hyper-radial revolving lights without prisms, and with lenses of 80° vertical angle. These lights are the work of Messrs. Chance.

Power or intensity of beam has also been attained by superposing one lens apparatus on another, increasing *pro tanto* the total effectiveness of the light. Mr. Brown of Lewisham, England, was the first (in 1859) to propose this arrangement of lenses, and Mr. Wigham of Dublin the first (1872) to carry it out in some fine Irish lights constructed by French makers. Messrs. Chance have since constructed striking examples of the biform type for Bishop Rock and Round Island, Scilly Isles, for the Bull Rock, Ireland, and for the Eddystone, English Channel.

A further method of intensifying lighthouse beams is the electric illuminant. Here the United States have not been backward in following the example of Great Britain and France, though the American use has been more conspicuous in buoys and beacons than in sea-lights like the St. Catherines in England, the Isle of May in Scotland, or the Cap Grisnez or Ushant in France.

It is, however, beginning to be understood that the electric light in its present condition is not, save in a few cases, to be too strongly recommended for lighthouse service. Its cost, when applied to large apparatus, both for instalment and for maintenance is very considerable, and in thick weather its superiority of penetration to the rays of gas or oil lamps of the present imposing dimensions is a much controverted point. It is, indeed, a mixed question, for the lighthouse engineer and the financial secretary, to be determined according to the nautical and economical conditions of each station. Yet it must never be forgotten that the true way of estimating the combined effectiveness and expense of a light is to divide the units of first cost and annual maintenance by the units of power or intensity.

A more important consideration seems to be that of distinctiveness. The early French plan of making a portion of the appartus of fixed optical sections and a portion of revolving optical sections has the obvious disability of inequality of range where the light is white throughout or red throughout, so that a vessel observing the flash at a certain distance can only see the fixed beam at a much less distance, and can only know the true character of the light after an interval more or less prolonged. When color is used for the revolving portion this difference is no doubt much diminished, but it is still too great. A light wholly of revolving sections is preferable for all purposes in these days of high speed and multiplied traffic. And it is the revolving light that affords a much greater number of characteristics than the fixed. The group-flashing system in double and triple series by optical combinations, first introduced by Dr. John Hopkinson and Messrs. Chance in 1875, has been adopted all over the world; and the gas group-flashing system of Mr. Wigham, of about the same date, has been extensively used in Ireland. Combinations of red and white flashing lights, where the former is rendered as powerful as the latter by special optical contrivances, have been repeatedly employed, especially by Messrs. Chance.

A very valuable form of distinction largely adopted in modern times, is the occulting light, that is, a fixed beam interrupted by a short darkness instead of a long darkness interrupted by a short flash as in a revolving light. The sharp contrast of dark and light is thus substituted for the old fixed light, and this is particularly valuable for ports and harbors where shore and ship lights are now so much more numerous and powerful than before. A very simple form of clockwork, designed by the writer, gives movement to the occulting screens for small lights and to the vertically dropping screen which is preferable for sea lights where the occulting system is accounted powerful enough for a sea-light. In occulting lights care should be taken that the duration of darkness should be sufficient to affect the eye sensibly, as, for instance, two seconds at least. There is a growing tendency, also, to make the flashes of revolving lights too short in duration or too quick in recurrence. The difficulty of identifying a light and of taking a bearing by it is thus much increased, and the wear and tear of the mechanism for rotating the apparatus becomes very serious despite the recent expedient of a mercury trough in which the framework revolves.

The most approved optical and mechanical arrangements for our lighthouses would be of little avail if the aliment oil or gas, which sustains the greater number of them, were of unsuitable quality. As regards gas there need be no other provision than that made for the town or harbor supply near the lighthouse, and the only need is to use it with adequate pressure in an appropriate burner in single or multiple jets or rings. As regards oil, the different vegetable varieties, the chief of which was colza, have now nearly fallen into disuse, giving place to petroleum in some of its many forms. The luminiferous properties of good oil and good gas are almost equal, but the cost of petroleum is not more than one-fourth that of vegetable oil, and not greater than that of gas, while its extreme pliability and convenience make it quite as valuable as gas. The lighthouse world is indebted to an American, Captain Doty, for first showing, twenty years ago, how mineral oil could be used in a multiple-wick burner, and it is indebted also to America for the largest and best supplies of the oil itself. The only drawback has been the undoubted greater risk of fire and explosion, but even this has been obviated by the introduction of the variety called "heavy mineral oil," which, having a flashing point of 240° to 270°, is almost absolutely safe. It is now generally used in Europe.

The improvement of burners fit for mineral illuminants has proceeded, as I have said, well nigh to perfection in the hands of the Trinity House of London and of their late engineer, Sir James Douglass. His six-wick burner is of the power of about 900 candles consuming about $\frac{9}{16}$ of a gallon per hour; his ten-wick burner is of about 2,200 candles, consuming about $1\frac{7}{10}$ of a gallon per hour. I believe that no form of the Doty or any other oil-burner equals this. The pressure-lamps of Messrs. Chance used with such burners seem to secure the maximum of advantage in the focus of any dioptric sea-light. Very much excellent work, however, in the way of improvement of burners, has been achieved by Major Heap and by Mr. Funck, his assistant at Tompkinsville.

It is a singular fact that, despite all the improvements of the dioptric system and the vital urgency of the matter, the side and mast lights of vessels still remain to a large extent in so imperfect a condition. In Paris and Birmingham, the only seats of the manufacture of dioptric lights, ship lights with true lenses have long been constructed on the same principles of the sea-lights which have a radius thirteen times as great. The writer has long urged, both publicly and privately, the employment of more powerful lights at sea, and more particularly the equalization of the power of these lights by using electricity in incandescent lamps of unequal intensity, in the colored side lights, so that meeting or passing vessels shall understand the course and character of each other at much greater distances than are now sanctioned by statutory rules. At the International Marine Conference in Washington, in 1889, the subject of ship lights was amply discussed with reference to azimuthal ranges and vertical divergences, and the conclusions formulated are being now internationally adopted. But the question of *greater intensity of beam* and of *equality of beam* does not appear to have been considered in relation to the greatly changed conditions of vessels thronging the high and narrow seas in these days, and to the ever-increasing frequency of accidents by collision at night. I earnestly hope that the authorities of the United States will yet again take the initiative in effecting this final improvement in ship lights.

In closing for the present these few remarks on lighthouses it is impossible not to give expression to feelings of admiration for the liberal and enlightened policy of the United States in maintaining the lighthouses of their immense coast-line free of toll to all the maritime world. America sets a shining example to many an older country in this as in many other ways May her maritime prosperity abundantly increase!

A JAPANESE SICK WITH SCARLET-FEVER.[1]

BY ALBERT S. ASHMEAD, M.D., NEW YORK CITY.

I HAVE been introduced to a Japanese gentleman, aged 23, living in Brooklyn, who is undergoing treatment by Dr. Benjamin Ayres for scarlet-fever. As this is the first case of scarlet-fever I have ever seen in a Japanese, I report it to you. To-day is the twenty-eighth day of the disease. There has been no temperature during the last two weeks. Desquamation has been general for three weeks, mostly behind the knees and about the shoulders. He has now scaly desquamation on the palms and soles; noticed first by the patient on the backs of the hands. The throat showed very marked symptoms and is even now very distinctly red and inflamed. Highest temperature 103½; no albumenaria.

I content myself with this short sketch, as, I think, Dr. Ayres will make a more complete report.

I am the more interested in this case, as it is supposed that the Japanese have an immunity from scarlet-fever. I have tried, without success, several times to inoculate a Japanese subject with the disease, in the hope of producing a protective virus. More recently I inoculated two children who had been exposed to the contagion of scarlet-fever with the blood-serum from a blister on the body of a child who, having had scarlet-fever previously, was artificially immune.

These children, whether protected or not, did not take the disease. More recently still, I have inoculated two cases of scarlet-fever with pure blood-serum from a blister on the body of an adult, who was also artificially immune. The inoculations were made in the arms on the third, fourth, and fifth days. In these latter cases there was no effect if diminished desquamation is not to be considered as one. Both cases ran a mild course. It is my opinion, on which, having so little to go upon, I would not insist too strongly, that blood-serum from an artificially immune subject has a virtue, if not curative, at least preventive. Dr. Seward of the Willard Parker Hospital promised me to make a further investigation in the scarlet-fever ward of his hospital.

I have given you these facts to show you what reasons I have to be particularly interested in the case on which I have summarily reported.

[1] Communicated to the Tei-I.-Kwai.

ELECTRICAL NOTES.

IF a student of molecular physics had been asked a few months ago for an explanation of the phenomenon seen when an electrical discharge is passed through a Geissler tube, he would not have hesitated in his reply. He would have shown, from the researches of J. J. Thomson and others, that the phenomenon, in the case of the non-striated discharge, is akin to that of electrolysis, that disassociation was a necessary accompaniment; that, in the case of the striated discharge, the electricity was carried partly by convection and partly by electrolysis, that this was shown by the fact that the conduction did not proceed with the velocity of light, that each stria was a place where electrolysis was taking place, and each dark band a place where the electricity was carried by convection, that the reason why the discharge was not produced with mercury vapor is that it cannot be disassociated, and that the reason that it takes place so readily with other gases is that the converse is the case.

But the recent work of Herr Hertz and Dr. Lenard has caused considerable doubt to be thrown on some parts of this theory. Not that the theory as given above may not be true after all, but it must first explain the phenomena discovered by the above-named scientists, and at present this seems difficult.

A short account of them is as follows: If we take a Crookes tube, i.e., a tube in which exhaustion has been carried to such an extent that the discharge is no longer visible, except where it strikes upon the glass, or some other solid or phosphorescent substance, we find that, as the exhaustion progresses, the rays issuing from the cathode, and producing incandescence or phosphorescence, instead of passing directly from the cathode to the anode, tend to move in a straight line, normal to the cathode. This discharge has been supposed, one might almost say proved, by Crookes, in a series of most masterly experiments, to consist of highly charged atoms of gas, repelled with great violence from the cathode. As the exhaustion becomes more and more thorough, fewer and fewer atoms are left in the tube, and consequently the trajectories of the atoms become more and more nearly straight lines, and, if the tube is bent at an angle between the electrodes, the discharge will strike against the glass.

If this is the real nature of the discharge, it would seem on first sight that it should not be able to pass through a metallic substance. Yet it has been discovered by Herr Hertz that this is not the case, that it passes readily through thin metal plates. From these two facts, that the discharge takes place in straight lines, and that it passes through thin metal plates, Dr. Lenard conceived the idea that it should be possible to produce the discharge in a Crookes tube and make it pass out into the air, and the experiment, when tried, proved successful.

The apparatus used was as follows: A Crookes tube, whose two ends we will call A and B, had the cathode electrode sealed in at A. This was of the usual form, and projected some distance into the tube. The anode consisted of a tube of aluminium, only a little smaller than the size of the glass tube containing it, and surrounding the cathode. On the discharge taking place it would, instead of passing directly from the cathode to the anode, as in the case where the gas was not so much rarefied, proceed normally from the cathode and out of the open end of the aluminium tube constituting the anode and strike against the glass at the other end of the Crookes tube. In these experiments, that end was cut off, and a metal plate cemented across the opening. In the middle of this metal plate a small hole, 1.7 millimetres, was drilled, and this was covered by a sheet of aluminium, .0003 millimetres thick. Consequently, when the discharge struck against the aluminium plate, the latter being permeable to it, it passed out into the air. This was shown by a luminous discharge just outside the sheet of aluminium, and by the fact that phosphorescent substances placed there behaved in the same manner as when exposed to the cathode discharge in a Crookes tube. If, in place of air, other gases were made to surround the aluminium plate, very different effects were obtained. If the gas was hydrogen, the discharge, after passing through the aluminium window, was not scattered so much. If carbonic acid gas, the scattering was much greater. Dr. Lenard points out that, as all gases at